Retrieval of Atmospheric Species From SAGE III

Inference of Aerosol Characteristics

Experimental Cross-Comparisons

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LOA group

Retrieval of Atmospheric Species From SAGE III

Solar occultation mode

Development of an inversion algorithm starting from SAGE III transmission measurements allowing the retrieval of vertical profiles of atmospheric species

• Theoretical work on simulated data with error budget accounting for probable transmission uncertainties and altitude registration uncertainties

$\Rightarrow$estimation of the product accuracy

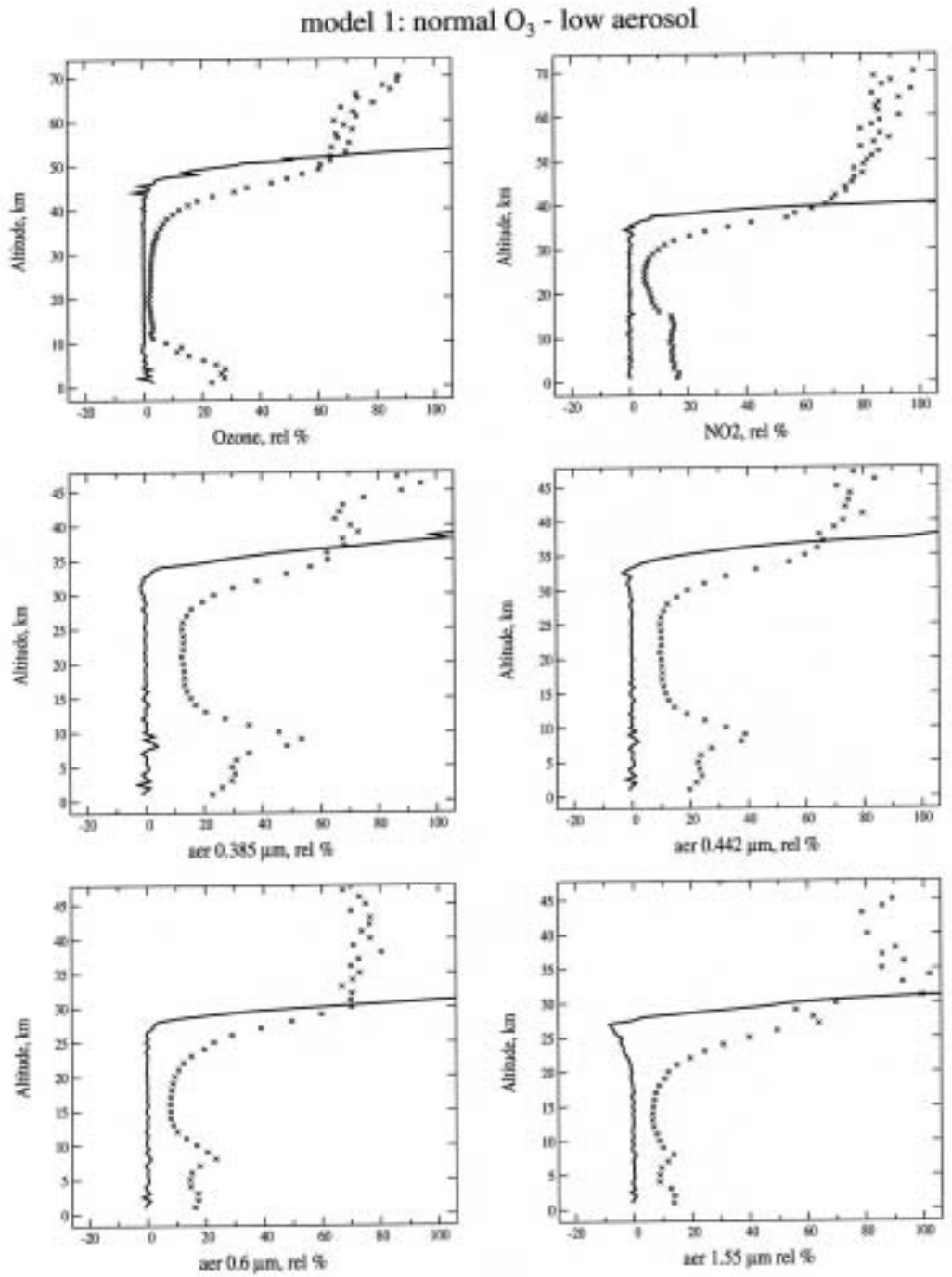
Technique similar to the inversion previously developed for SAGE II and POAM II-III :

- applied over the whole wavelength range 0.385-1.55 μm
- uses NO_2 and O_3 retrieved from the two resolved channels in the NO_2 absorption region (0.433-0.450 μm) and in the Chappuis band (0.559-0.624 μm).

(Bazureau et al., GRL, 2000; Brogniez et al., JGR, 2002)

Model atmosphere tested:

- normal ozone content with low or high aerosol content
- ozone hole with low or high aerosol content and PSC



__ relative systematic uncertainty

x relative random uncertainty

SUMMARY:

No bias below 30-50 km depending on the species

Random errors :
NO_2 retrieved within 20% in [0-35km]

		low aerosol content	high aerosol content
[10-40km]	**O_3**	<5%	<10%
		Close to the hole accuracy very poor	
	Aerosol extinction coefficients:		
[10-25km]	short λ :	10-30%	<10%
[10-25km]	long λ :	5-20%	<10%
		Close to the PSC accuracy very poor	

• Currently : application to actual SAGE III measurements
⇒ comparison to results from operational LaRC-inversion algorithm
⇒ comparison of error budgets to determine the product accuracy

Lunar occultation mode

Preliminary results with resolved channels for OClO, NO_3 encouraging (Bazureau and Brogniez, ISSSR'99, 1999; Bazureau et al., SPIE, 2000).

Algorithm needs to be modified since we started from transmission.

LOA and IASB groups

Inference of Aerosol Characteristics

Optical inversion of spectral aerosol extinction coefficients

SAGE III is the first instrument to observe the aerosol and PSCs at so many wavelengths

⇒ **the retrieval of the aerosol and PSCs physical properties is expected to be improved**

- LOA inversion algorithms (CLI, + one under development)

(Anderson et al., JGR, 2000)

- No assumption on the shape of the size distribution

- Retrieved aerosol parameters: particle surface area, volume, effective radius

- IASB inversion algorithms

(Bingen et al., Ann. Geoph, 2003)

- Assumption: monomodal lognormal size distribution

- Retrieved aerosol parameters: particle number density, mode radius and width

Work planned: cross-comparison of aerosol products retrieved with LOA, IASB and LaRC techniques for SAGE III and also for SAGE II (V6.1)

$\Rightarrow$ evaluation of the errors on the inferred aerosol parameters.

Also planned : application of LOA technique to POAM II-III for comparison with SAGE II-III in case of close coincidences.

Experimental Cross-Comparisons

Spectral slant optical thickness profiles of SAGE III and of SAGE II, will be cross-compared with similar measurements performed by other space-borne instruments at close λ during close coincidences:

- POAM III
- SCIAMACHY, GOMOS onboard ENVISAT **

Species vertical profiles from SAGE III and SAGE II will be cross-compared during close coincidences with measurements from **satellite:**

- POAM III
- OSIRIS onboard ODIN, SCIAMACHY, GOMOS, MIPAS **

** *For the new instruments onboard ODIN and onboard ENVISAT which were launched recently, cross-comparisons will be achieved for the benefit of the different experiments.*

Some species vertical profiles from SAGE II and SAGE III will be compared with **ground-based measurements** performed routinely in European stations. Coincidences with the two instrument overpasses will be selected.

Balloon-borne measurements, already planned for the ENVISAT validation, performed either in the tropics or at mid- or high latitudes, will be used for the validation of several species inferred from both modes of SAGE III during close coincidences.

GROUND-BASED MEASUREMENTS

Validation of SAGE III lunar occultation ozone measurements:

Ozone lidar operating at Observatoire de Haute Provence 44N, 5.7E (OHP)

with close coincidence method or equivalent latitude method

Validation of SAGE III solar and lunar occultation stratospheric and mesospheric temperatures:

T-lidars operating at OHP (44N), La Réunion (21S), Andoya (69N)

BALLOON-BORNE INSTRUMENTS

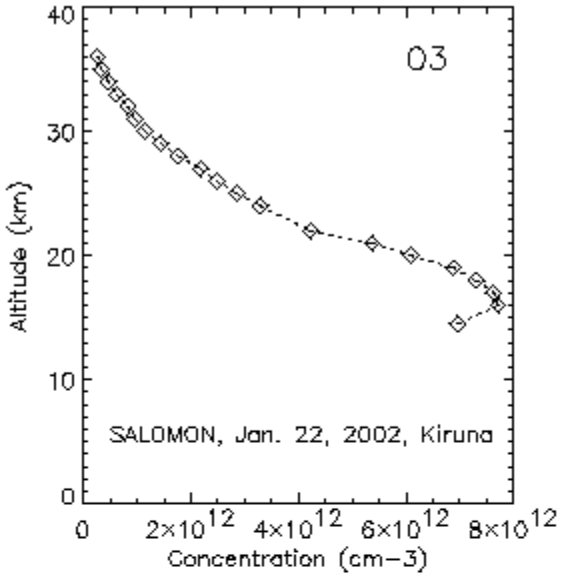
LABS

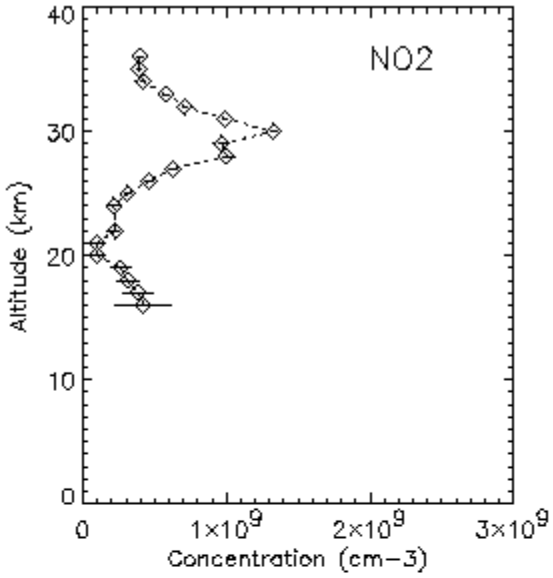
Solar Occultation :

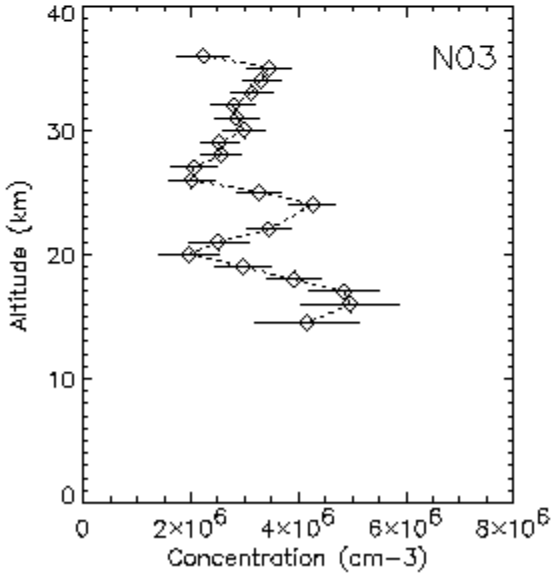
- **SAOZ :** O_3, NO_2, BrO, CH_2O, OClO, H_2O, O_4, aerosols / PSC / sub-visible cirrus — SA
- **ELHYSA :** H_2O, T, P (troposphere > 5km, stratosphere) — LMD
- **Counter :** aerosols (troposphere, stratosphere) — LMD
- **microRADIBAL :** aerosols (stratosphere) — LOA
- **LPMA :** O_3, NO_2, H_2O (IR configuration); O_2, H_2O (NIR configuration); P et T — LPMA

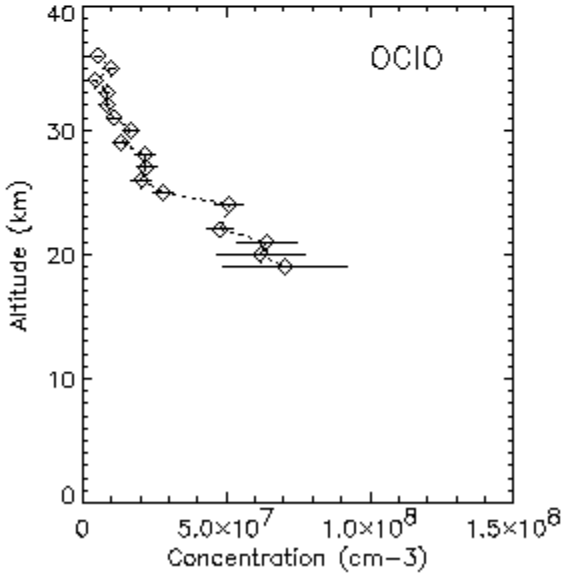
Lunar Occultation :

- **ELHYSA :** H_2O, T, P (troposphere > 5km, stratosphere) — LMD
- **Counter :** aerosols (troposphere, stratosphere) — LMD
- **SALOMON :** O_3, NO_2, OClO, NO_3, aerosols (stratosphere) — LPCE



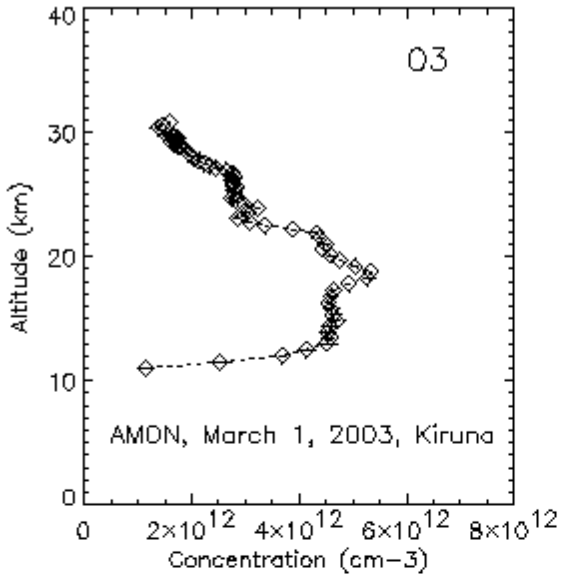


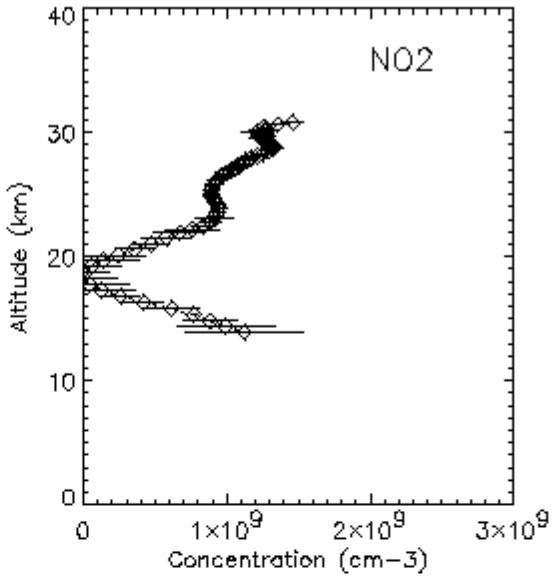


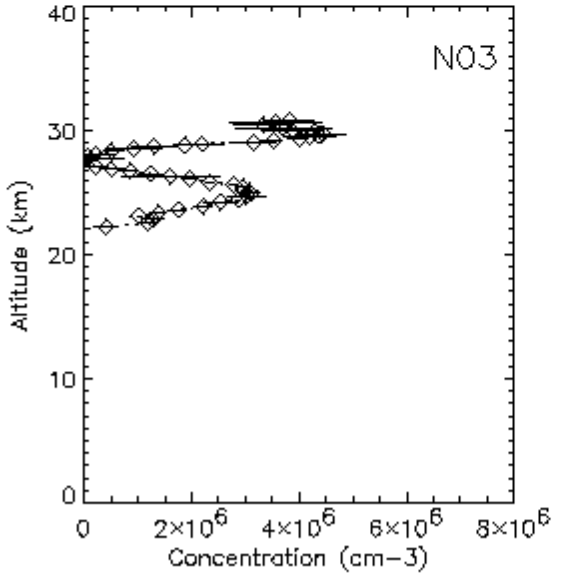


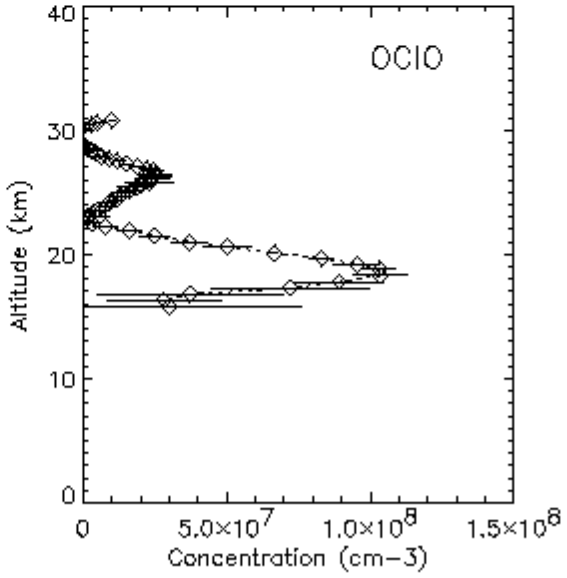
SALOMON

(LPCE)


O3
AMON, March 1, 2003, Kiruna
Altitude (km)
Concentration (cm−3)
0
10
20
30
40
0
2×10^12
4×10^12
6×10^12
8×10^12


NO2
Altitude (km)
Concentration (cm−3)
0
10
20
30
40
0
1×10^9
2×10^9
3×10^9

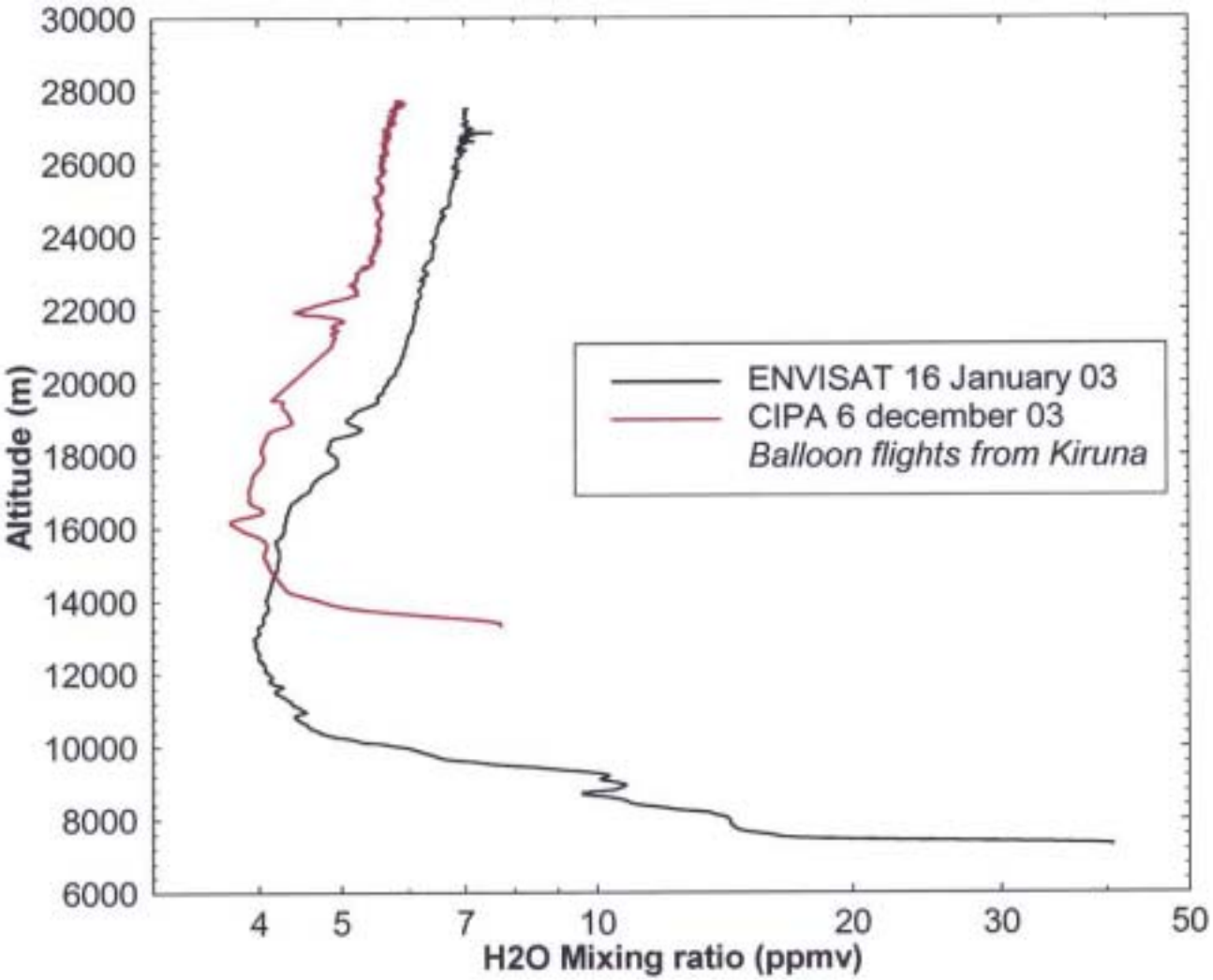

NO3
Altitude (km)
Concentration (cm−3)
0
10
20
30
40
0
2×10^6
4×10^6
6×10^6
8×10^6


OClO
Altitude (km)
Concentration (cm−3)
0
10
20
30
40
0
5.0×10^7
1.0×10^8
1.5×10^8

AMON

(LPCE)

ELHYSA (LMD)


30000
28000
26000
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
Altitude (m)
4
5
7
10
20
30
50
H2O Mixing ratio (ppmv)
ENVISAT 16 January 03
CIPA 6 december 03
Balloon flights from Kiruna

OTHER WORKS PLANNED

- The accuracy of SAGE III is expected to be better than of SAGE II : focus on the aerosols above 25 km to compare with balloon measurements (LMD, LOA, LPCE)

- With several occultation experiments (SAGE II-III, POAM II-III) : estimate of the stratospheric aerosol optical depth for correction of total aerosol optical depth (European project DAEDALUS, (IASB, LOA))